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Comparison of Neurologic Trauma and Motorcycle Helmet Use in Drivers vs Passengers

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This study compares postcrash prevalences of neurological and head and neck injuries in motorcycle drivers and passengers, stratified by helmet use.

Motorcycle crashes are associated with significant morbidity and mortality in both passengers and drivers. According to the National Highway Traffic Safety Administration, the proportion of fatalities attributed to motorcycles, compared with other passenger vehicles, has increased. With more than 8 million motorcycles on the roads, prevention of these injuries is essential to public health and the economy.

Helmets have been shown to reduce fatalities and serious traumatic injuries sustained from motorcycle crashes. Neurologic and other head and neck trauma accounts for a large portion of morbidity associated with these crashes. Although the utility of safety equipment in prevention of these injuries has been shown, few studies have investigated the neuroprotective benefit of helmet use on motorcycle passengers in comparison with motorcycle drivers.

Methods

Using the 2007-2010 data set of the National Trauma Data Bank, we identified motorcycle trauma patients by *International Classification of Diseases, Ninth Revision (ICD-9)* E codes (E810-E819), which specify external causes of injuries. The injured patients were divided into 2 groups: motorcycle drivers and passengers. Demographic data, including age, sex, race, helmet status, alcohol and drug use, and obesity status, were obtained. The rate of helmet use was compared between motorcycle drivers and passengers, and the correlation between patient characteristics and helmet use was assessed using bivariate analysis. Outcomes including Glasgow Coma Scale (GCS) scores, Injury Severity Scores (ISS), traumatic brain injury (TBI), and other head and neck injuries were analyzed and compared.

The data set was obtained as part of a quality improvement initiative and contained no patient identifiers. It was therefore exempted by Richard L. Roudebush Veterans Affairs Medical Center from institutional board review approval and patient consent protocols.

Results

A total of 79 818 drivers and 5896 passengers were identified. Drivers were significantly more likely to be male (91.9%; $P < .001$), use alcohol or drugs (22.6% and 21.2%, respectively; $P < .001$), and wear helmets (66.2%; $P < .001$) than passengers. Fewer than half of drivers and passengers under the influence of alcohol wore helmets (42.4% and 49.1%, respectively). The most frequent injury among unhelmeted drivers and unhelmeted passengers was TBI (46.5% and 46.9%, respectively). Overall, passengers were shown to have significantly higher rates of TBI compared with drivers (40.3% and 36.1%; $P = .002$). This difference remained significant after adjusting for age, sex, drug used, and alcohol use status. The mean GCS scores were similar between drivers and passengers (13.2 and 13.1); however, GCS scores increased with helmet use in both groups (drivers: 12.6 vs 13.5; $P < 001$; passengers: 12.5 and 13.5; $P < 001$). Although there was no difference in head and neck injuries between helmeted passengers and drivers, Table 1 details how helmet compliance was associated with a reduction in head and neck injuries in both passengers (43.7% and 47.1%) and drivers (21.4% and 20.7%). Table 1 also summarizes how the helmeted groups had higher GCS scores, lower ISS, and less TBI ($P < .001$). Table 2 compares odds ratios (ORs), detailing that helmets were associated with a significant reduction in the rates of TBI and head and neck injuries for both drivers (TBI: OR, 0.51; 95% CI, 0.50-0.53; head/neck injuries: OR, 0.60; 95% CI, 0.56-0.69; $P < .001$) and, to a lesser extent, passengers (TBI: OR, 0.29; 95% CI, 0.28, 0.3; head and neck injuries: OR, 0.35; 95% CI, 0.31-0.39; $P = .002$).

Discussion

Previous studies have estimated approximately 39% of veterans report having been in a motor vehicle collision, and 8% of those involve a motorcycle. In 1975, all but 3 states had mandatory helmet laws for motorcycle riders. However, since the US Congress eliminated the federal requirement for states to

maintain universal helmet laws, only 19 states now have them. Given the lack of a common law, this study was designed to compare the neuroprotective benefits of helmet use between motorcycle passengers and drivers. Helmet use among passengers and drivers was shown to be relatively low, with passengers being less compliant overall. Comparison of the effects of helmets on TBI and other head and neck injuries revealed a greater protection for drivers than passengers. However, helmet use was shown to be neuroprotective for both passengers and drivers, with significantly lower rates of TBI and head and neck injuries, higher GCS scores, and lower ISS among those who had worn them. The significant reduction in these injuries, and the lower rate of helmet use among certain demographics, calls for special intervention to promote helmet use, with an emphasis on individuals least compliant with this safety measure. Universal helmet laws might be necessary to improve morbidity and mortality associated with motorcycle crashes.

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Figures and Tables

Table 1.

Comparison of Injuries Between Drivers and Passengers, Stratified by Helmet Use[a]

Variable	Passengers	Drivers	*P* Value
Helmet Status			
Unhelmeted			
Head and neck injury	1093 (43.7)	12 719 (47.1)	<.001
Traumatic brain injury	1176 (47)	12 544 (46.5)	.61
Mean GCS score	12.61	12.51	.31
Mean ISS	13.46	14.46	<.001
Helmeted			
Head and neck injury	727 (21.4)	10 946 (20.7)	.32
Traumatic brain injury	1205 (35.5)	16 297 (30.9)	<.001
Mean GCS score	13.5	13.6	.58
Mean ISS	12.6	13.3	<.001
Passenger/Driver Status			
Passengers	Unhelmeted	Helmeted	
Head and neck injury	1093 (43.7)	727 (21.4)	<.001
Traumatic brain injury	1176 (47)	1205 (35.5)	<.001
Mean GCS score	12.6	13.5	<.001
Mean ISS	13.5	12.6	<.001
Drivers			
Head and neck injury	12 719 (47.1)	10 946 (20.7)	<.001
Traumatic brain injury	12 544 (46.5)	16 297 (30.9)	<.001
Mean GCS score	12.5	13.6	<.001
Mean ISS	14.5	13.3	<.001

Abbreviations: GCS, Glasgow Coma Scale; ISS, Injury Severity Scores.

[a]Unless otherwise indicated, data are reported as number (percentage) of individuals.

Table 2.

Comparison of Helmet Effectiveness in Injury Prevention Among Drivers and Passengers

Injury	Odds Ratios (95% CI)		*P* Value
	Passengers	Drivers	
Traumatic brain injury	0.62 (0.56-0.69)	0.51 (0.5-0.53)	<.001
Head and neck injuries	0.35 (0.31-0.39)	0.29 (0.28-0.3)	.002